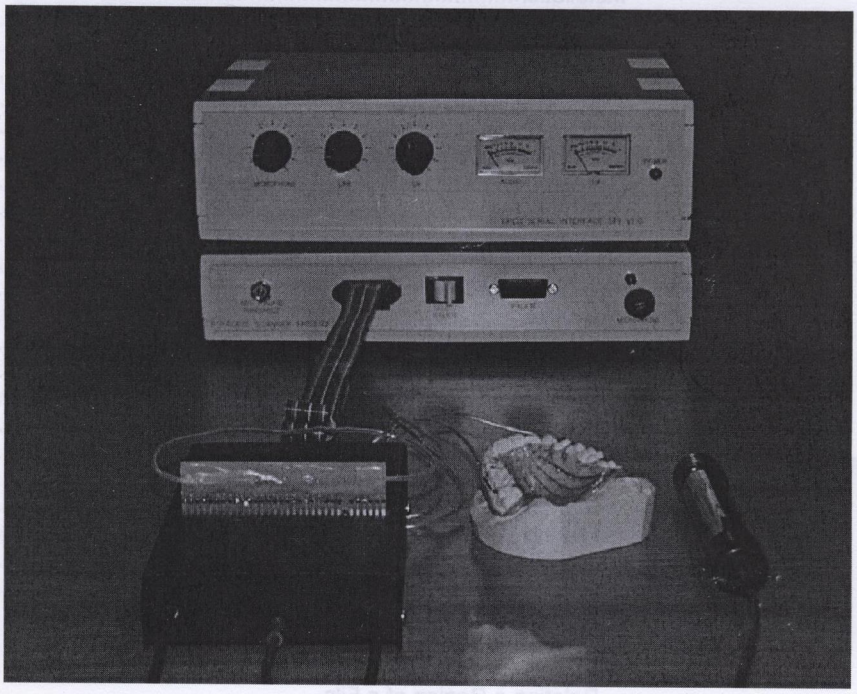
WinEPG
USERS MANUAL



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1 Preliminaries

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Definitions

EPG	Electropalatograph
SPI	Serial Port Interface unit
MIT	Medical Isolation Transformer
D.C.	Direct current

Warranty

Queen Margaret University College warrants the Electropalatograph against defects in materials and workmanship for a period of one year from receipt by the user. During that warranty period, the Queen Margaret University College will either, at its option, repair or replace products, which prove to be defective. Queen Margaret University College can accept no responsibility if the Electropalatograph is used other than in accordance with the instructions supplied. This warranty applies to the initial purchaser only and is not transferable.

Computer Recommendations

Sound card

Some PCs are sold with poor quality sound cards built into the motherboard. Such soundcards tend to have inaccurate sample rates and do not have line-level stereo input. Poor sample rate accuracy will result in poor synchronisation with the EPG signal. Without a line-level stereo input it is not possible to record a second channel e.g. Laryngograph. It is therefore recommended that a separate sound card be used for research applications.

Video display

The minimum recommended screen resolution is 800 x 600 for satisfactory display of numerous analysis windows with colour depth > 256 bits

Memory

Audio and EPG data are stored in computer memory during recording and so the amount of memory determines the length of recording that can be made. The system will run with 32Mbytes of memory on Windows 95/98. However, 64Mbytes memory or greater is recommended for Windows 95/98/2000/NT and a minimum of 128Mbytes of memory is recommended for Windows XP.

Hard disk

The size of the hard disk simply limits the amount of data that can be stored. One minute of audio (22050Hz mono) and EPG data takes up 2.694Mbytes of disk. A 20Gbyte hard disk will therefore have room for more than 100 hours of audio/EPG data.

Data backup device

It is highly recommended that the computer has a backup/archiving device such as a writeable CDROM drive (CD-RW) or that the computer can be connected to

a network with such a device. Data should be backed up on a regular basis in case the computer develops a problem that results in data being lost.

General EMC (Electromagnetic Compatibility) Guidelines

Shielded serial cable

Using the shielded serial cable supplied with the system ensures that you maintain the appropriate EMC classification for the intended environment.

Electromagnetic Interference

Electromagnetic interference (EMI) is any signal or emission, radiated in free space or conducted along power or signal leads, that endangers the functioning of a radio navigation or other safety service or seriously degrades, obstructs, or repeatedly interrupts a licensed radio communications service. The WinEPG system is designed to comply with applicable regulations regarding EMI. In particular it complies with standards for medical electrical equipment and information technology equipment used in medical electrical application.

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2 Getting Started

Hardware System Features

- **Safety**. No direct connection between client and power source. All connections are capacitance coupled and opto-isolated. Medical grade components are used throughout.
- **Microphone Pre-amplifier**. The Serial Port Interface unit incorporates a pre-amplifier, which boosts a microphone signal to a line-level signal to enhance the signal quality. The line-level signal output can be fed into a line-level input available on better quality computer sound cards.
- **Synchronised Laryngograph Input**. The Serial Port Interface Unit also allows the output of a Laryngograph to be fed into a pre-amplifier The pre-amplifier is designed to be highly linear which prevents phase distortion of the signal and the line-level signal output is synchronised with the line-level microphone output.
- **Line-level Input**. For convenience, a line-level signal may be fed *into* the Serial Port Interface unit. This signal is unchanged by the system except for having a synchronisation tone added at the start of each recording.

WinEPG System Description

The WinEPG system includes the following ***supplied*** components:

- Multiplexer with chrome handgrip
- EPG3 scanner unit
- Serial Port Interface (SPI) unit
- Cables and adapters
- Microphone/headphone

To operate the system the following ***additional*** items are required:

- Windows 9x/2000/NT/XP computer with sound card and serial port (standard on most PCs)
- A 220-240V or 110V main power supply
- An electropalate, custom made for each client

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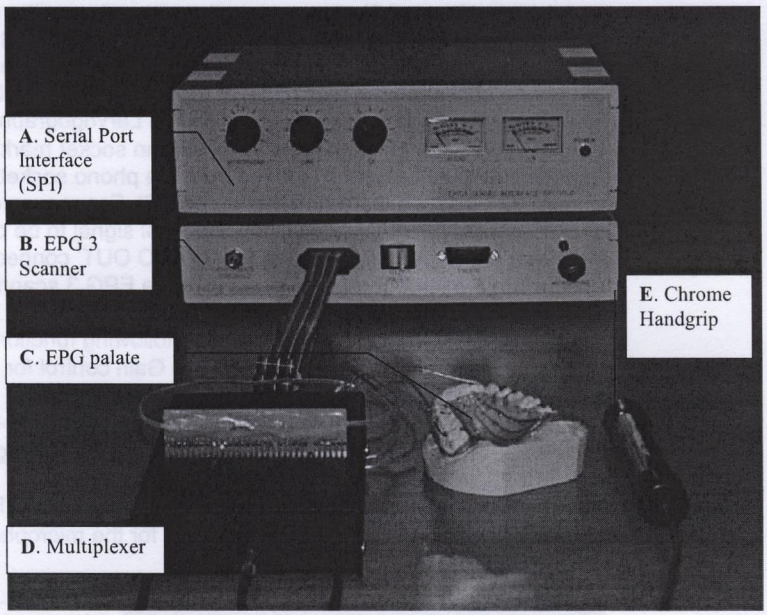

Figure 1 WinEPG hardware

EPG Palate

The EPG palate (Figure 1**C**) comprises an acrylic palate fitted with 62 silver contacts wired to a multiplexer input connector. EPG palates must be manufactured to fit each individual client. See section 5 for EPG palate manufacturer address.

Multiplexer

The EPG palate plugs into the connector slot on the multiplexer (Figure 1**D**), which is suspended from a cord around the client's neck. The client should hold the chrome handgrip (Figure 1**E**), which plugs into the side of the multiplexer box to complete the contact circuit. The purpose of the multiplexer is to reduce the 62 EPG palate contacts down to an 8-wire cable connection to the EPG3 scanner unit input.

EPG 3 Scanner

Two input connectors marked 'PALATE' (Figure 3**C,** Figure 3**H**) (or A and B on the old EPG 3) are provided to enable a therapist to alternately view the client and the therapist's own palate for demonstration purposes. The white switch (Figure 3**F**) is used to select either input A or input B. A second multiplexer is required to support this mode of operation. The palate threshold adjustment control (Figure 3**E**) allows the sensitivity of the EPG3 scanner to be adjusted. A microphone input socket (Figure 3**K**) is provided (See following SPI section for more details). An indicator above the microphone socket lights up when the EPG3 scanner is properly connected and receiving power from the SPI unit.

Serial Port Interface (SPI)

The Serial Port Interface (SPI) powers the EPG3 scanner and controls its operation in response to instructions from the host computer. The SPI sits on top of the EPG 3 scanner and is connected to the EPG 3 scanner by a short cable from the 25-way D connector on the rear panel of the EPG3 scanner (Figure 2**K**), marked 'EPG CONTROL', to the connector on the rear panel of the SPI marked 'EPG3 CONTROL'. *NB. A different cable is required to connect the old DOS EPG 3 unit. See upgrade section.* The SPI is connected to the computer serial port (usually marked COM1 or COM2 or sometimes '10101' or RS232) using the 2m

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serial cable (Figure 3**C**) plugged into the connector on the rear panel of the SPI marked 'Host RS232'. The SPI unit provides pre-amplification for a microphone plugged into the EPG 3 scanner. The line-level preamplifier output is taken from the phono socket on the rear panel of the SPI marked 'AUDIO OUT' (Figure 2**G**). The SPI is designed to take the input from a Laryngograph and pre-amplify it. The Laryngograph can be connected to the phono socket marked 'LX IN' (Figure 2**I**) and the line-level Lx output is taken from the phono socket marked 'LX OUT' (Figure 2**F**), both on the rear panel of the SPI. For convenience a fourth phono socket marked 'LINE IN' allows any line level signal to be connected to the SPI. Note that this signal will be fed to the 'AUDIO OUT' connector and should not be used when a microphone is plugged in to the EPG 3 scanner.
There are three gain controls on the front panel of the SPI marked 'MICROPHONE', 'LINE' and 'LX' with the following functions:

- **Microphone**. (Figure 3**B**) Gain control for the microphone plugged into the EPG3 scanner.
- **Line**. (Figure 3**A**) Gain control for the line-level input to the SPI
- **Lx**. (Figure 3**D**) Gain control for the Laryngograph plugged into the SPI.

There are two meters on the front panel marked 'AUDIO' (Figure 3**G**) and 'LX' (Figure 3**I**), which indicate the signal levels for the microphone and Laryngograph respectively.

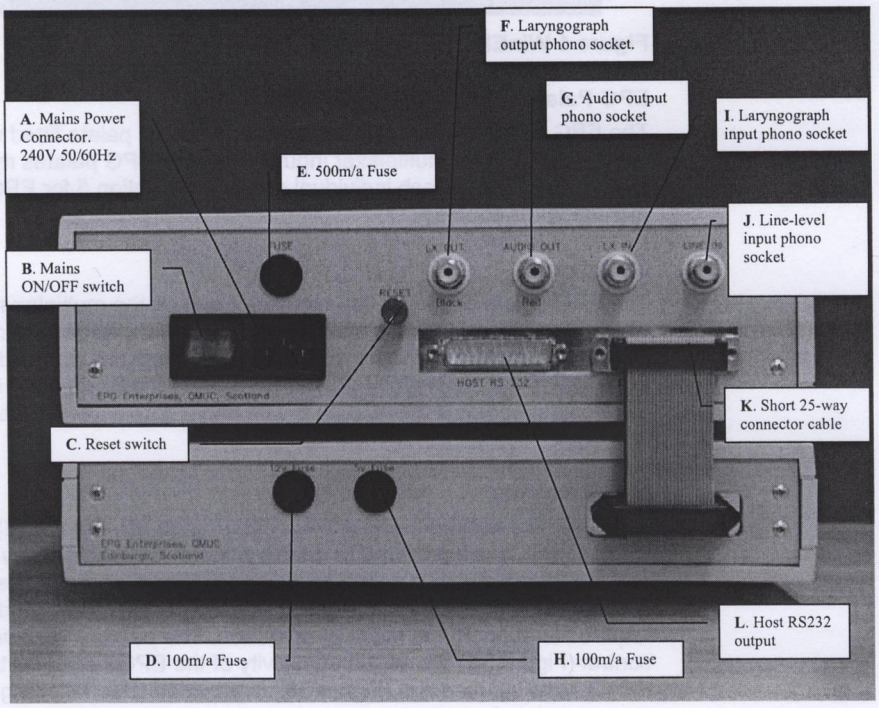

Figure 2 Rear Panel of SPI unit and EPG3 Scanner

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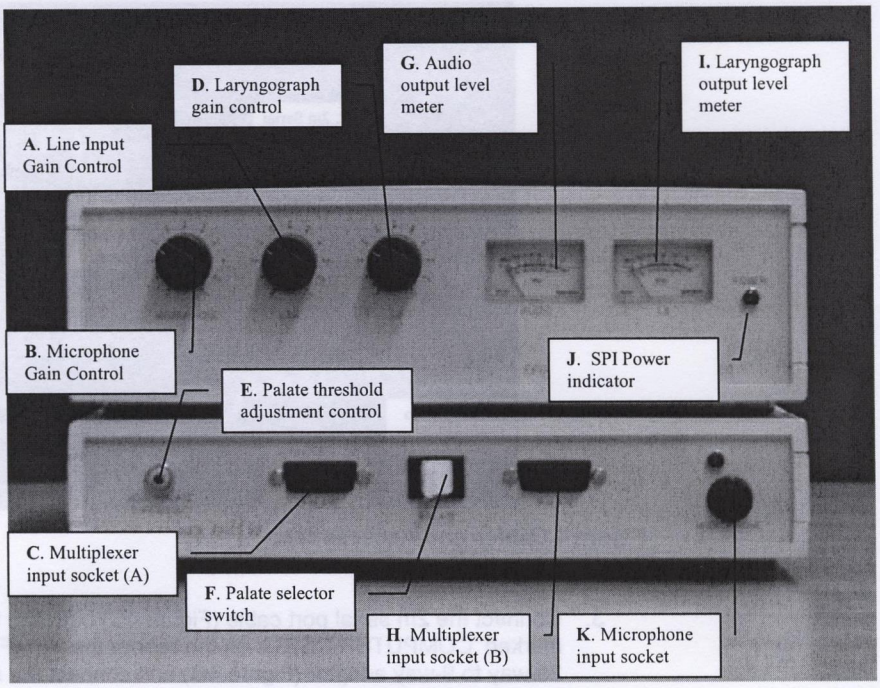

Figure 3 Front Panel of SPI unit and EPG3 Scanner

Installation

Please read through these steps carefully and completely before you assemble the system. At the end of the process if you can record and playback speech and record and display EPG patterns on the computer, the system is correctly installed and configured.

WinEPG Hardware

1. Place SPI on top of the EPG 3 scanner
2. Connect the SHORT 25-way ribbon cable (Figure 4**A**) between the connector marked 'COMPUTER' on the rear of the EPG 3 scanner and the connector marked 'EPG CONTROL' on the rear of the SPI. IMPORTANT: Only the short 10cm 25-way cable supplied should be used. Any other cable may cause serious damage to the system. See below if you are upgrading from the old DOS EPG system as a different cable is used.

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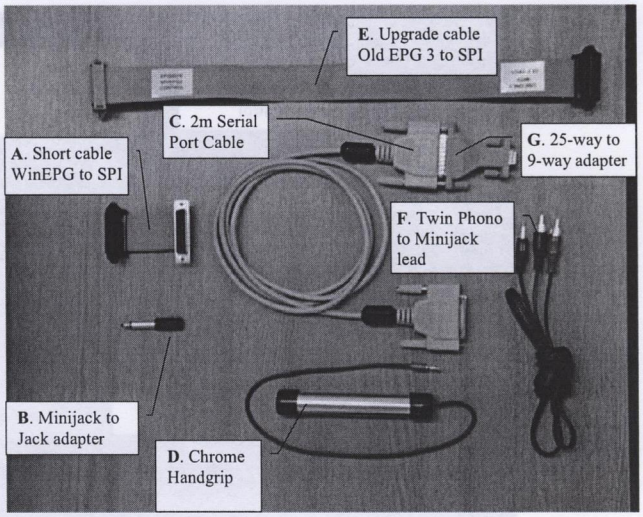

Figure 4 Cables and Accessories

3. Connect the 2m serial port cable (Figure 4**C**) between the connector marked 'COMPUTER RS232' on the rear of the SPI (Figure 2**L**) to the 25-way to 9-way adapter (Figure 4**G**) and connect the adapter to the 9-pin serial port connector on the back of your PC. The serial port connector may be marked as 'COM 1' or '10101'.
4. Plug the main power lead into the rear of the SPI then plug the lead into a suitable power supply and switch on the power.

> **Important**: See following section regarding the use of a Medical Isolation Transformer.

5. Switch on the green power switch on the rear panel of the SPI (Figure 2**B**). After 6 seconds you should hear a beep. If not check that orange light on the front panel of the SPI marked 'POWER' is illuminated. If the switch is not illuminated there is no power reaching the SPI.
6. Plug the multiplexer cable into one of the sockets marked 'PALATE' on the front of the EPG 3 scanner and make sure that the white palate selector switch (Figure 3**F**) is pointing towards this socket.
7. Plug the chrome handgrip (Figure 4**D**) into the multiplexer.
8. Plug an EPG palate into the multiplexer (Figure 1**D**).
9. Hang the multiplexer around the subject's neck, tying a knot in the cord to ensure the multiplexer rests at a comfortable height and so that there is no strain on the EPG palate when it is in the subject's mouth.
10. Connect the microphone to the microphone input on your computer's sound card.

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Alternatively: If your sound card has a line-level input, you may plug your microphone into the socket on the front of the EPG3 (Figure 3**K**) scanner unit. A Power Supply Adapter is now supplied with the system to provide phantom power for the supplied condenser headset microphone.

The adapter is NOT required if the microphone is plugged directly into a modern PC sound card as the PC supplies power to the microphone.

The adapter IS required if the supplied condenser headset microphone is plugged into the EPG3 unit as this unit does not supply phantom power.

Also, it is possible that some old soundcards may not supply phantom power.

To connect the supplied headset condenser microphone to the EPG3 scanner (see Figure 5), first plug the white microphone minijack into the EMA-20 power supply adapter then plug the EMA-20 into the SPI. The EMA-20 requires an AAA size 1.5V battery and has an off/on/volume switch.

Connect the twin phono to minijack lead (Figure 4**F**) from the red and black phono connectors marked 'AUDIO OUT' and 'LX OUT' on the rear panel of the SPI to the line level input socket on your sound card. Be careful to match the red and black plugs to the red and black sockets.

11. Run 'Articulate Assistant v1.0' software on the PC.

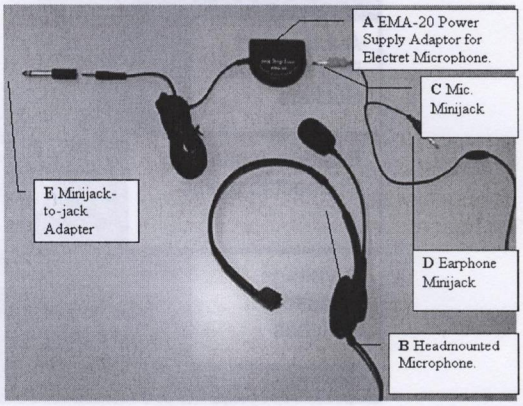

Figure 5 Head-mounted condenser microphone and power adapter

Medical Isolation Transformer

If the WinEPG system is to be used by patients for speech therapy/pathology or any other medical purpose, it is necessary to use an isolated medical power supply with EN60601-1 approval. Patient safety may be compromised if a medical isolation transformer is not used as indicated in this section.

An isolation transformer is used as a means of complying with several of the electrical requirements of IEC 60601-1 which governs the manufacture and use of medical devices. It allows the use of equipment which form part of the WinEPG system which otherwise would not comply with IEC 60601-1, e.g. PC, monitor, printer.

Its function is to isolate the neutral line from earth and it can be simply set up to handle 110V or 230V power systems.

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Note: Make sure that the Voltage Selection Switches (Figure 6**C**)for the Input and Output are appropriately set for the mains supply. The default setting will be 240 Volts for both the input and the output to suit European mains supplies. Fuse ratings for different settings are marked on the case next to the switches. The fuses should be changed if necessary to match the selected voltage settings. See the Technical section at the end of this manual for more details on selecting voltages.

When using the Medical Isolation Transformer, Step 4. in the previous section should instead read:

4. Plug the mains power lead into the Medical Isolation Transformer (Figure 6**B**) then plug an output power lead (Figure 7) into one of 4 outputs on the medical isolation transformer unit and connect the other end of the output power lead to the rear of the SPI. The PC to which the WinEPG system is connected, the PC monitor and any other peripheral devices connected to the PC that require a power supply should also be powered via the remaining medical isolation transformer outputs. The medical isolation transformer input should then be connected to a mains power socket and the power switched on.

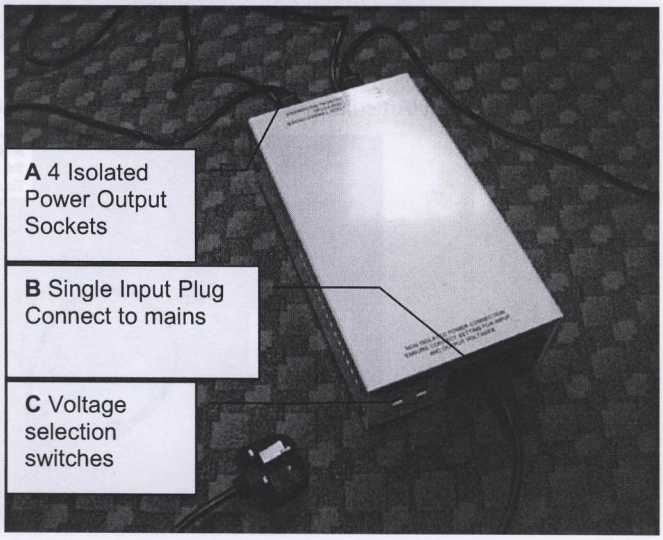

Figure 6 Medical Isolation Transformer (MIT)

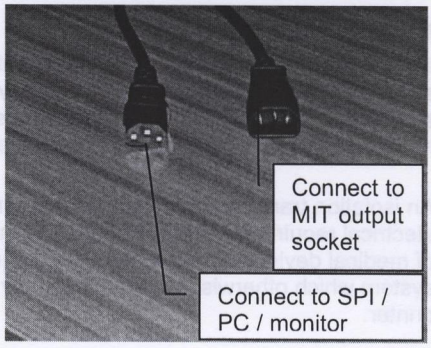

Figure 7 Output Power Cable

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Upgrade from DOS EPG 3 system

The installation procedure is the same as for the WinEPG system with one important exception. The cable connecting an old EPG3 scanner (Figure 8) is wired differently to the new EPG3 scanner (green panels). The upgrade cable (Figure 4**E**) is also longer to account for the different position of the 'COMPUTER' connector on the rear of the old EPG3 scanner.

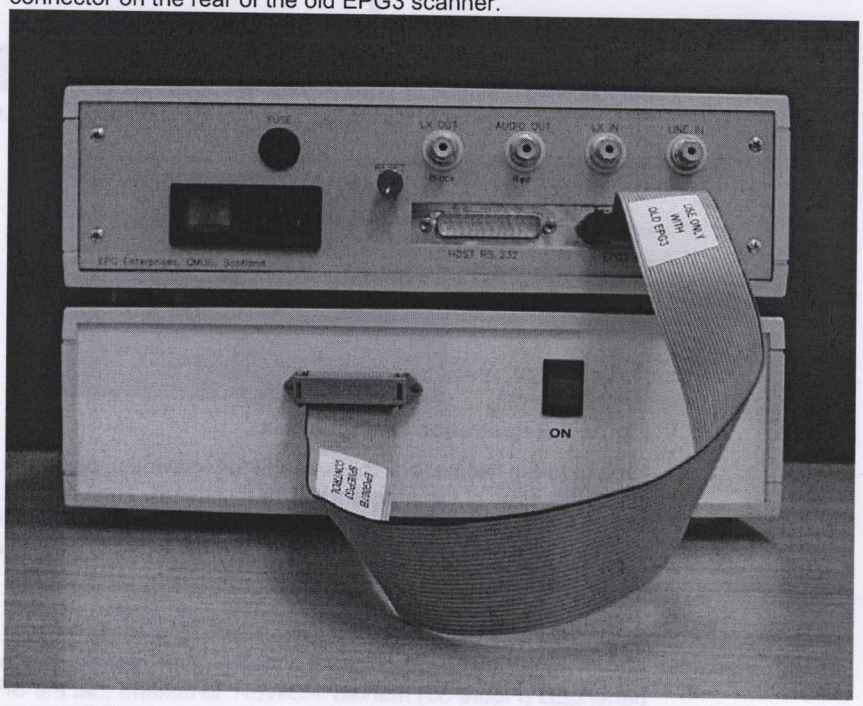

Figure 8 Rear panel of SPI and Old DOS EPG3 Scanner

Software Installation

Close any program you have running on your computer.
Insert the 'Articulate Assistant' CDROM
Use 'Windows Explorer' or similar to find the install.exe file on your CDROM Drive and double click. The software will load automatically.

System Setup

Installing Articulate Assistant Software

To install the software, place the Setup CD in the CD player of your PC and run 'Setup.exe' from your CDROM drive. This will install the Articulate Assistant software under the 'Program Files' folder in 'ArticAsst' folder. The program can be run from the Windows Taskbar Start Menu ('**Start:Programs:ArticAsst:ArticAsst**').

Registering Articulate Assistant Software

Articulate Assistant software must be registered before it can be used. To register, run 'ArticAsst.exe' and click on the '**Help:Registration...**' menu to show

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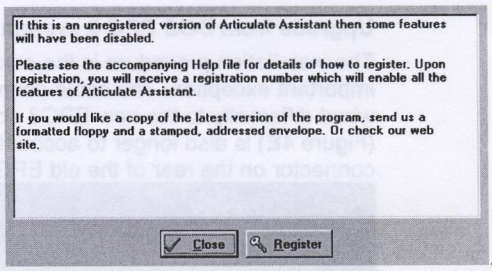
the following dialogue box 

. Then click on the Register button to bring up the Registration Dialogue box (Figure 9).

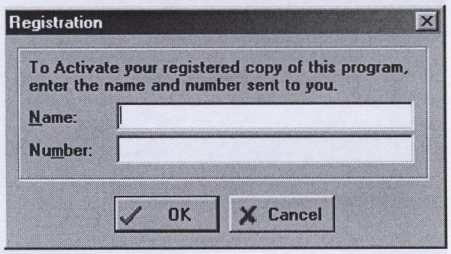


Figure 9 Registration Dialogue Box

Type in to the 'Name' box the name of the individual, company or institution to which this copy of the program will be registered. Then contact the manufacturer at the email address given at the end of this manual to obtain the registration 'Number'. Note: The Name and Number must typed in exactly as provided by the manufacturer.

EPG

Switch on the SPI by operating the switch on its rear panel. Observe the front panel LED (Figure 3**J**) marked 'POWER' to confirm that the SPI is powered. Observe the similar LED on the front panel of the EPG3 scanner to confirm that the EPG3 scanner is powered.

Run 'Articulate Assistant' software. The display should look similar to Figure 10.

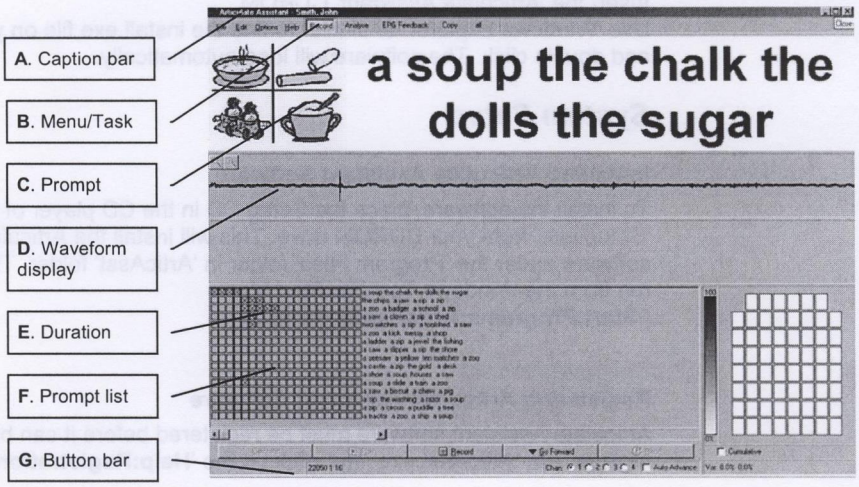


Figure 10 Record Task Window

The contact area should provide live feedback of contact between the tongue and the EPG palate. If the display does not respond, check that the handgrip is

plugged in and being gripped by the client. Try pressing the RED RESET button on the rear of the SPI. You should hear a beep after 6 seconds and the palate display should go live. If there is still no response it may be that the communication port parameters supplied with the software are incorrect and need to be changed.

To change the communication port setting:

Select the menu option 'Options' then select the submenu option 'Comms…'. The COM port entry should normally be 'COM1'. If it reads 'COM1', try changing it to 'COM2'. If it reads 'No port' then try 'COM1'.

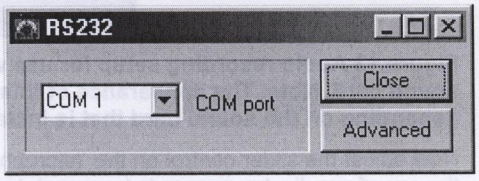


Figure 11 Com port selection dialogue

TIP: If an EPG palate is not available it is possible to check that the system is working by stroking the multiplexer socket with a coin whilst holding the chrome handgrip.

Audio

Next, check the audio signal level.

If using line-level input (see WinEPG hardware setup 10. above), then check that the audio meter (Figure 3**G**) is responding to the microphone signal. Adjust the control knob marked 'Microphone' until the needle on the meter rises above 8 but below 0 while speaking into the microphone.
If line input is not available on you computer then the microphone should be connected directly to the PC soundcard microphone input.

Now talk into the microphone and the audio display should be similar to the one below. If there is no signal (a flat line in the display) then the audio software setup needs to be changed.

Figure 12 Wave display showing audio signal at correct level

In Articulate Assistant, select the menu option 'Options:Audio…' Then click on the dialogue button marked 'Recording Control'.

If line-in is being used then make sure the 'line–in' checkbox marked 'enabled' is checked and the 'microphone' checkbox marked 'enabled' is unchecked. If Laryngograph is not being used then the checkbox marked 'mono' should also be checked.

If microphone is plugged directly into the PC soundcard 'microphone' input then the dialogue should appear as below.

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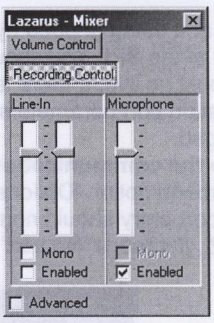


Figure 13 Audio recording setup for use with direct microphone input to sound card. Note. The appearance of this dialogue is liable to change depending on the sound card that is installed

Now adjust the slider control on the 'microphone' or 'line-in' (as appropriate) until the waveform display responds to speech input to the microphone. Then close the dialogue box by clicking the X at the top right corner.

Congratulations. You are now ready to record audio and EPG data with Articulate Assistant.

3 Using Articulate Assistant Software

Software Features

- **Simple data management**. The software automatically manages files, grouping files according to client and session without the need to open, save or name individual files.
- **Client-based**. Individual clients or experimental subjects can be called up and notes taken and stored along with recorded data.
- **Easy to use.** The software comes with an intuitive interface designed to be easy to operate for non-technical users.
- **Flexible**. Advanced users such as researchers can build and store display layouts to suit particular tasks. Such users can also define their own analysis values and set parameters.
- **Multilevel annotation** Data can be labelled with unlimited keywords. These keywords can be used to search and retrieve data throughout all annotated files.
- **Compatible.** All analysis values generated by the program can be exported to a tabbed text file suitable for importing into most statistical and database packages.

Overview

Articulate Assistant™ V1.0 is a full-featured articulatory display tool for Windows 95, 98 2000, XP and Windows NT. Articulate Assistant is designed to allow Speech & Language Therapists and Speech Scientists to record and analyse data produced by articulatory instrumentation such as EPG.

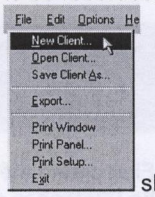
Articulate Assistant is designed to work on 2 levels.

- The first level requires no adjustment of parameters or technical knowledge. It is simple to use the onscreen buttons and pre-configured task windows to achieve basic recording, therapy and analysis functions .
- The second level allows the user to design their own task windows and manipulate parameters through menu options and dialogue boxes. This allows the advanced user to define their own measurements.

The Basics

Loading a Client

The first thing to do when the program is started up is to check that you have the correct client loaded. The client name or reference number is displayed on the Caption bar (Figure 10**A**) at the top of the main window. The first time the program is started, the tutorial client 'John Smith' will be loaded. If a new client is to be recorded or analysed then the '**File:New Client...**' menu option



should be selected and the 'Client Dialogue Box' should be filled in, in a similar manner to the tutorial client shown in Figure 14.

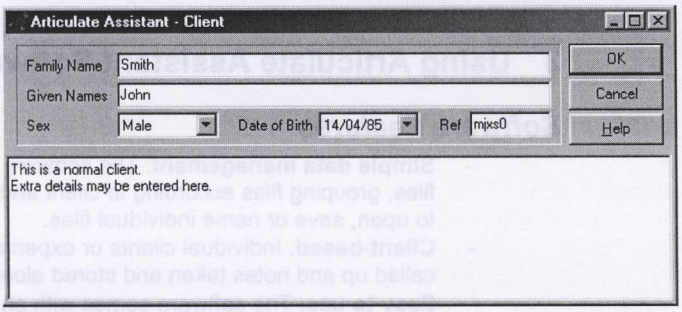


Figure 14 Client Dialogue Box

Client details need only be entered once. Thereafter, the client can be reloaded using the '**File:Open Client**' menu option. Notes may be added at any future time by using the '**Edit:Client...**' menu option. For convenience, the client data that is being worked on when the program is closed, is automatically loaded when the program is next started up.

NB. All the client details and data files created in 'Articulate Assistant' are automatically saved. The '**File:Save Client As...**' menu option provides an easy way to save a copy of the entire client data record to a backup device.

Creating a List of Prompts

The list of prompts can be changed with the '**Edit:Prompt List...**' menu option which calls up the 'Prompt List Editor' (Figure 15). To create a new list of text prompts, select the 'File:New...' menu option in the Prompt List Editor as shown in Figure 15. Then type your prompts, one per line, into the large blank window. To save your prompt list

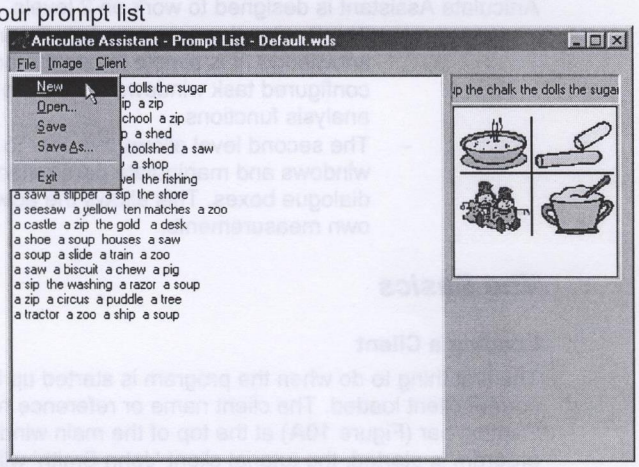


Figure 15 Prompt List Editor

TIP: If you already have a list of prompts in a text file. Simply copy the list to the clipboard using <Ctrl c> in your text editor and paste into the Prompt List Editor using <Ctrl v>

An image can be associated with each prompt. First create the image using your favourite program (e.g. Paint, Boardmaker, Adobe Photoshop etc.). This can be a drawing or a photograph. Copy the image to the clipboard from within that program. Then, from the Prompt List Editor menu, select '**Image:Paste**'.

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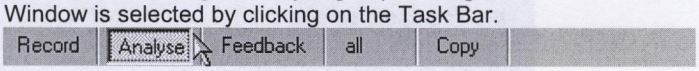
Selecting a Task Window

Within Articulate Assistant there are windows configured to help the user perform certain tasks like Recording or Analysing or providing EPG Feedback for therapy. A Task Window is selected by clicking on the Task Bar.



The Record Task Window

The recording Task window is shown in Figure 10. It is designed principally for the purpose of recording sets of utterances. The display provides the prompts for the speaker and provides checks on the quality of the recorded data.

Making Your First Recording.

The first recording in a session is achieved in the following way:

1. Select the prompt to be recorded by clicking on the prompt in the prompt list (Figure 16**C**) so that the selected prompt is highlighted.
2. Check that the waveform display is live (i.e. responds to the microphone).
3. Press the Record button [Record].
4. Once pressed the legend on the button changes to Stop [Stop] allowing the user to stop the recording by pressing the same button.

> **TIP:** If the Stop button is not pressed then the recording will automatically stop after 6 seconds. This default can be changed using the '**Options:Display: Utterances:Maximum Duration**' menu option.

After recording has stopped, the software checks to see if the recording is too loud (clipped) or too quiet. And gives a warning. The recording has already been saved. The waveform and EPG files are displayed and can be visually checked and played back if necessary to confirm that the recording is OK.

Redoing Your Recording

If a recording is unsatisfactory because it is too loud, too quiet or the client said the wrong thing, then it is easy to re-record using the Redo button [Redo]. The Redo button is available for up to 1 minute after a recording has been made in order to provide a simple means to overwrite the last recording that was made. If a recording needs to be replaced after that time then it must be selected, deleted and recorded again.

Making Your Second Recording

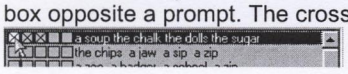
If you wish to record a second repetition of the same phrase, simply press the record button [Record] again.

If you wish to record the next prompt in the list, press the Go Forward button [Go Forward]. Then press the record button [Record].

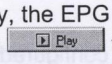
> **Alternatively:** You can select any prompt for recording by simply clicking on the text in the prompt list (Fig. **12C**).

Selecting and Playing a File

A recorded file is represented by a crossed box in the 'Prompt List' display (Figure 16**A**). Empty boxes (Figure 16**B**) are simply place markers showing than no data was recorded for a particular session or prompt. To play a file that has been recorded by the current client, simply select a file by clicking on a crossed box opposite a prompt. The crossed box will turn white.



The file will be displayed in the wave trace

display, the EPG palates display and other data displays. Then click on the Play button 

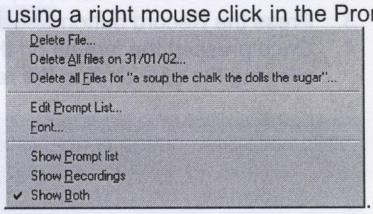
to hear the whole file.

TIP: You can also play the file back at half speed by clicking the **right mouse button** on the waveform display and choosing the **Play Slowly x 2** option from the popup menu.

Grouping Recordings into Sessions

The date and time of a recording is automatically stored. All recordings made in one day are grouped and separated by a blue session separator line (Figure 16**D**) . If you hover the cursor over a box in the 'Prompt List' display the date and time of the recording are revealed as a 'Hint' next to the cursor. The date and time of a recorded file are also displayed ion the status panel (Figure 16**H**) if a file is selected.

Deleting Files

Files may be deleted by using a right mouse click in the Prompt List display to invoke the popup menu 

. There are three options for deleting files. Either:

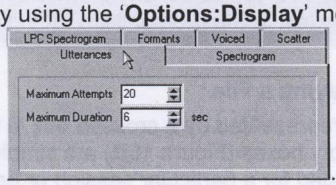
- **Delete File**. Delete the selected file.
- **Delete All Files on <date>**. Deletes all files recorded in one session. Note. This will delete files that are not visible too. See next section.
- **Delete all Files for <prompt>**. Deletes all recordings of the selected prompt.

Controlling the Prompt List Display

The popup menu described in the previous section can be used to determine the files which are visible in the 'Prompt List' display.

- **Show Prompt list**. When engaged in the task of recording files it is advantageous to show only the prompts which you mean to record i.e. the prompts in the currently loaded prompt list.
- **Show Recordings**. When performing analysis it is only necessary to see files which have been recorded.
- **Show Both**. The default is to show both.

It is possible to increase the size of the boxes in the prompt list by selecting the '**Font...**' option from the popup menu and increase the font size.

The default number of recordings (columns of boxes) is 20. This can be increased by using the '**Options:Display**' menu and clicking on the tab marked **Utterances** 

. The '**Maximum Attempts**' can be edited to increase it above 20.

With a larger number of 'Attempts' selected it may be necessary to use the scrollbar at the bottom of the 'Prompt List' display to bring the session of interest into view.

Selecting and Zooming into a Region

To select a region, click the left mouse button and drag on the waveform display.

To Zoom In to the region, click on the icon .

To Zoom out to see the whole file, click on the icon

Deleting a Region of a File

To delete a region of the file:

1. Select the region to be deleted. (This might typically be some extra speech accidentally recorded at the beginning or the end of the file.)
2. Click on the right mouse button in the Waveform window to bring up the popup menu and click on the '**Delete Selected**' option.

Automatic Prompt Advance

For convenience, it is possible to make the prompt advance automatically to the next one in the list by checking the Auto Advance checkbox (Figure 16**J**). When Auto Advance is checked, the Go Forward button is replaced by a Go Back button . Using the Go Back button it is possible to move back to the last recorded file.

Note: If you wish to redo a recording when Auto Advance is checked, you must press the Go Back button then the Redo button

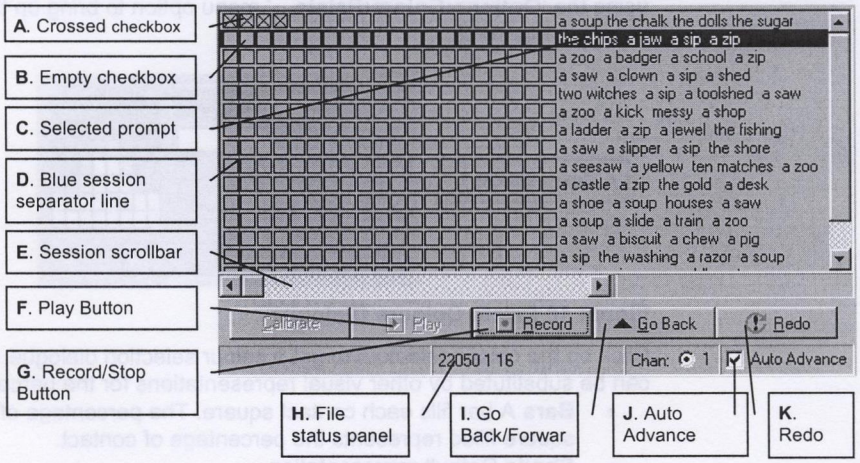


Figure 16 Recording Listbox, Buttons and Status bar

Single Palate Display

The 'Palate Display' shows an average contact pattern for the currently selected region of the file. Or, it shows the current palate frame if no region has been selected.

TIP: To quickly scan through an EPG recording, click the Play button and watch the 'Single Palate Display'. Alternatively, click and drag the mouse along the 'Palates Display' (Figure 23).

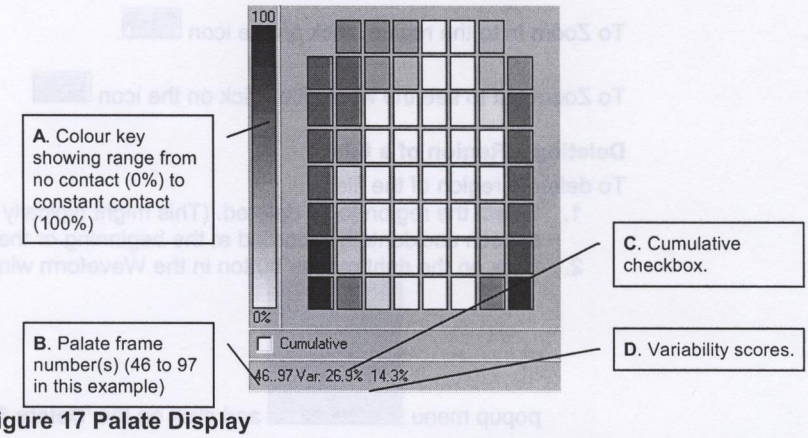


Figure 17 Palate Display

Palate frames are numbered in sequence from the start of each file. The frame number (or numbers, if a region is selected) is displayed below the palate display (Figure 17**B**).

Palate Colour Scale

The colour key to the right of the single palate display maps the display colours to a scale which shows the percentage of selected frames for which each contact is on. For example, in Figure 17, the bottom right-hand contact is dark in colour. By reference to the colour key this indicates that this contact is on in all the frames in the selected region (frames 46 to 97). The colours of the palate can be changed using the '**Options:Colors:Palate...**' menu option to bring up the dialogue box shown in Figure 18.

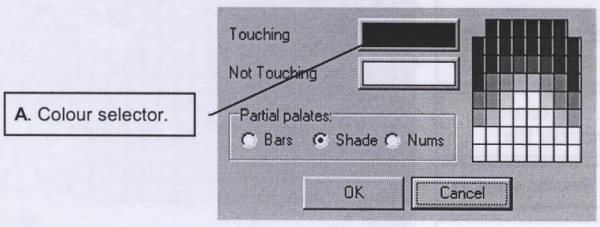


Figure 18 Palate Colours Dialogue

Click on the colour selectors to get a colour selection dialogue. The shading scale can be substituted by other visual representations for the percentage contact.

- **Bars** A bar fills each contact square. The percentage of the contact square filled represents the percentage of contact.
- **Shade** Default representation.
- **Nums** Represents as a numerical percentage.

Variability Scores

The Variability Index provides a value for the stability/variability of articulatory gestures. To calculate the index, the percent frequency of activation of each contact across frames is measured. For each contact, 100% and 0% activation frequency represent invariance and are assigned a variance index of 0. The variability index increases as contact frequency approaches 50%, which is assigned a maximum index of 50. The overall variability index is calculated in to forms

1. by summing the index values for all contacts and dividing by 62.
2. by summing the index values for all contacts with more than 0% contact and dividing by that number of contacts.

These two indices are shown in this order below the Single palate Display (Figure 17**D**). An index value of 0 represents invariance, the higher the variability index the more unstable the EPG patterns (maximum index value is 50).

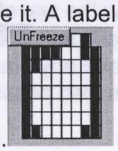
Cumulative Checkbox

If the 'Cumulative' checkbox in the 'Palate Display' is set ☑ Cumulative, then when a contact comes on it will stay on until the checkbox is unchecked.

> **TIP**: Checking the 'Cumulative' checkbox is a good way to check whether all the contacts on a users palate are still working OK

Freezing the Palate Display

It is possible to freeze the Single Palate Display so that the palate pattern does not change with live input or with the movement of cursors in a recorded file. Simply click anywhere on the Single Palate Display to freeze it and do the same again to unfreeze it. A label saying "UnFreeze" will appear to indicate that the display is frozen.



The File Status Panel

The file status panel (Figure 16**H**) Shows the sample rate (default = 22050Hz) number of channels (default = 1 for mono recording) and the number of bits per sample (default:16). When a recorded file is selected, the file status panel displays the prompt text with the date and time that the file was recorded.

Annotation

The Analysis Task Window is shown in Figure 19. It is designed, principally, to allow the audio and EPG data to be annotated.

Annotation can be made on the basis of the audio data by observing the waveform, the spectrogram or by playback. Annotation can also be made on the basis of EPG by observing the EPG palate sequence (Figure 19**D**) or the analysis values (Figure 19**E**) derived from the EPG such as total contacts or Centre of Gravity. Automatic annotation is also possible by selecting maximum or minimum points in a given analysis value trace (e.g. Find all the regions in a sentence where there are more than 4 contacts on in the posterior palate row).

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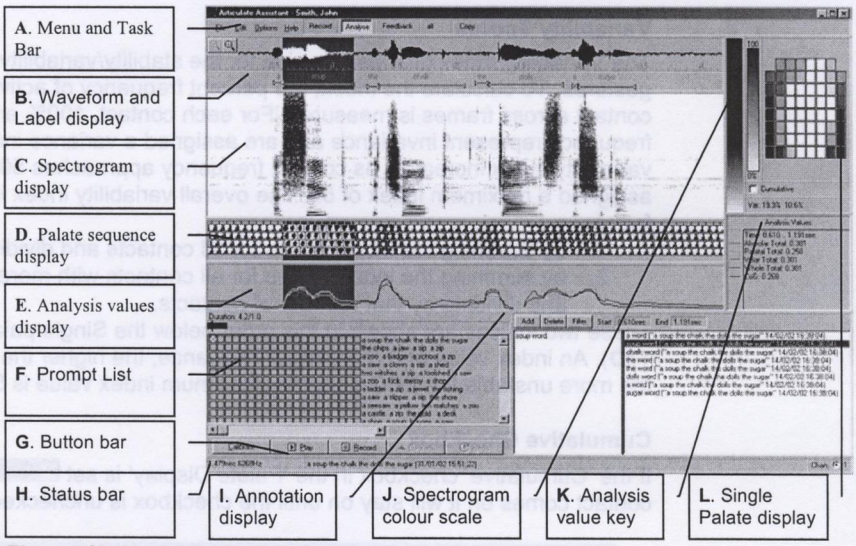
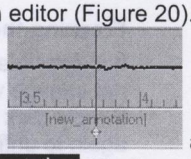
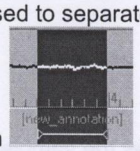


Figure 19 Analysis Task Window

Annotating the Waveform

To annotate the waveform, place the cursor at the point you wish to annotate. Then press the Add button in the Annotation editor (Figure 20). An annotation marker will appear below the waveform  and the Annotation Editor will show the default text <new_annotation>. Replace this text with your own label, which should not have any blank characters in it. An underscore can be used to separate words. It is also possible to select a region of the waveform  and annotate it.

Adding Keywords and Notes to the Annotation

An *annotation keyword* is any text separated by a space character on the first line of annotation and can be used as the basis for searching through all annotated files. The first *annotation keyword* is also the label, which appears under the waveform as described in the previous section. You can add as many *keywords* as you like. Any text typed on the second and following lines in the lefthand panel of the Annotation Editor are regarded as *annotation notes. Annotation notes* are stored and can be recalled but they are not searchable.

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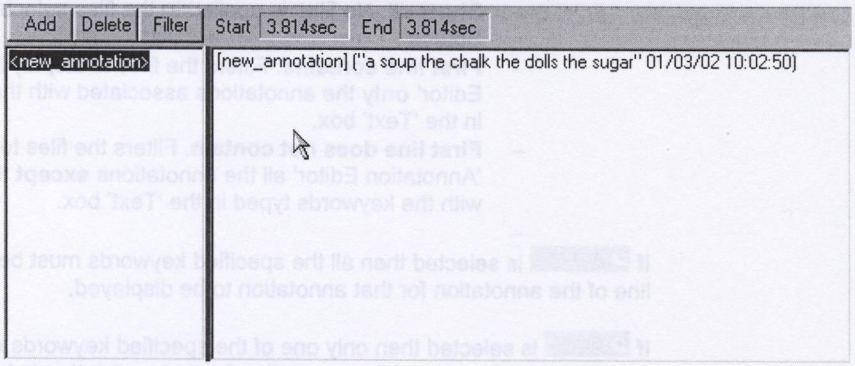


Figure 20 Annotation Editor

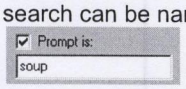
Searching for Annotations using the Filter

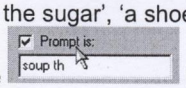
The Annotation Editor will, by default, display every annotation for every utterance by the current client. However, it is possible to control which annotations are displayed by using the Annotation Filter (Figure 21).

Filter Source

The files to be searched can be filtered according to:

- **This recording**. Shows only annotations within the current file.
- **This prompt**. Shows annotations for all repetitions and across all sessions for the current prompt.
- **This client**. Shows annotations for all files recorded by current client.
- **All clients**. Shows all files recorded by all clients.

If 'This client' or 'All clients' are chosen then the search can be narrowed by specifying the prompt or part of the prompt. E.g. 

would narrow the search in the example set of prompts in Figure 11. to 'a soup the chalk the dolls the sugar', 'a shoe a soup houses a saw' and 'a soup a slide a train a zoo' while 

is enough to specify 'a soup the chalk the dolls the sugar' uniquely.

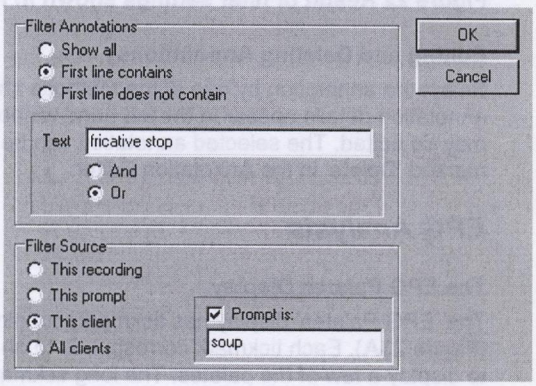


Figure 21 Annotation Filter. The example shown defines a search through all files for the current client which have the word 'soup' in the prompt and find all the annotations which are annotated with either 'fricative' or 'stop' keywords in the first line of the annotation

Filter Annotations

The second level of filtering refines the search according to the keywords in the first line of the annotation. The options are:

- **Show all.** No filter is applied to the files selected in 'Filter Source'.
- **First line contains**. Filters the files to display in the 'Annotation Editor' **only** the annotations associated with the keywords typed in the 'Text' box.
- **First line does not contain**. Filters the files to display in the 'Annotation Editor' all the annotations **except** those associated with the keywords typed in the 'Text' box.
-

If And is selected then all the specified keywords must be present in the first line of the annotation for that annotation to be displayed.

If Or is selected then only one of the specified keywords needs to be present in the first line of the annotation for that annotation to be displayed.

The result of the filter settings in Figure 15 on the tutorial client 'John Smith' is shown in Figure 22.

Selecting Annotated Regions to Play, Analyse or Edit

There are two ways to select an existing annotated region.

1. Click on the annotation marker on the waveform display (or). If there are several markers close together then you will be given a choice.
2. Click on the annotation listed in the 'Annotation Editor' (as in Figure 22). This has the added advantage that it will automatically load the correct file.

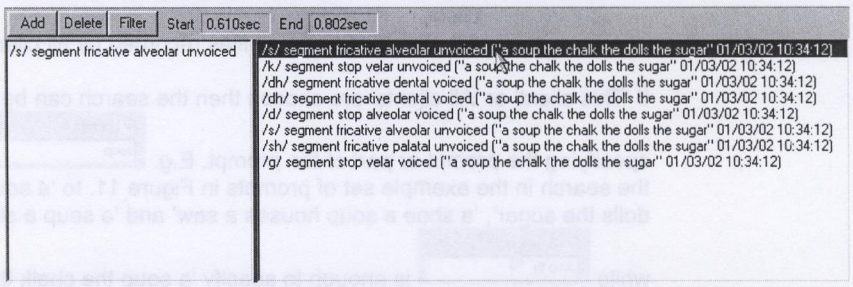


Figure 22 Result of filter settings shown in Figure 21 for the tutorial client

Editing and Deleting Annotations

Select the annotation by one of the methods shown in the previous section. The annotation details appear in the left hand window of the Annotation Editor. These may be edited. The selected annotation can be deleted by clicking on the button marked 'Delete' in the Annotation Editor.

EPG Analysis

The EPG Palates Display

The 'EPG Palates' display has tickmarks running along the top of the display (Figure 23**A**). Each tickmark corresponds to an EPG palate but there is only room to display a few of the palates. The long tickmark (Figure 23**C**) that is connected to each displayed palate, indicates the moment in time that the palate was recorded. To see a sequence of EPG palates it is necessary to zoom in or resize the EPG palates display. See the following section on resizing displays. Reducing the height of the EPG Palates display will increase the number of displayed palates. Note that if there are tick marks between the palates that are displayed. Then zooming in or resizing the display will reveal them.

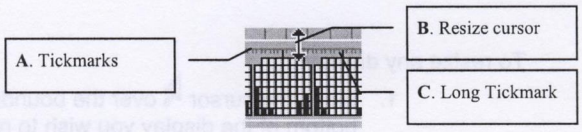
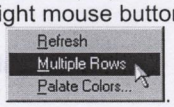


Figure 23 EPG Palates Display

If zooming in or reducing the size of the EPG Palates display is undesirable, there is another way to view all the palates. Using the right mouse button, click in the EPG Palates window to reveal the popup window 

. Then click on the '**Multiple Rows**' option. The 'Multiple' EPG palates display (Figure 24) will then create as many rows as necessary to show all the palates.

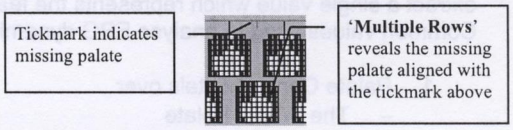
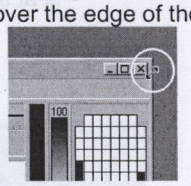


Figure 24 EPG Palates Display (Multiple Rows)

Resizing Displays

As with any Windows program, task windows and dialogues within Articulate Assistant may be resized by moving the cursor over the edge of the window and



clicking and dragging with the left mouse button.

Articulate Assistant also allows most displays within a task window to be resized. That is to say that some parts of a task window may be made larger at the expense of others. This is mostly a matter of personal preference but you may wish to resize in order to:

- Make the contents of the Prompt display more visible Figure 25.
- To show more palates (See previous section)
- To format a window in preparation for printing.

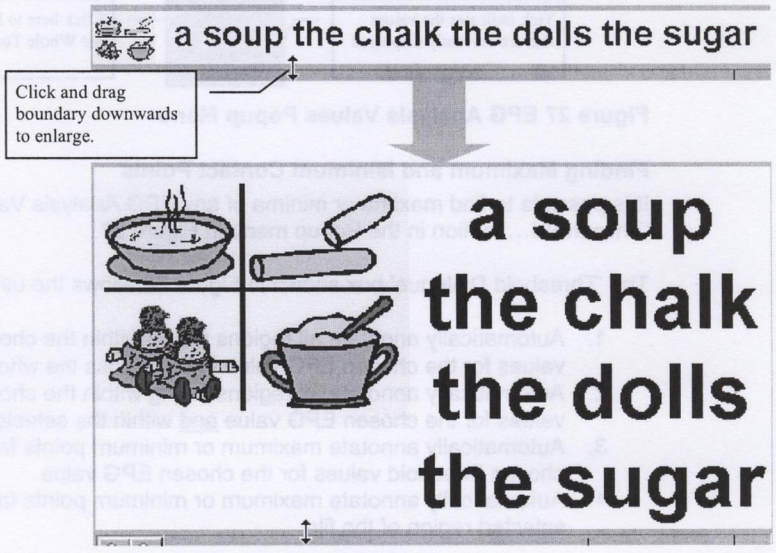


Figure 25 Resizing the Prompt display

To resize any display:

1. Move the cursor over the boundary to the left, right, top or bottom of the display you wish to resize until it changes to look like this or this ↔.
2. Click and drag with the left mouse button in the direction of the arrows

EPG Analysis Values

It is very useful to be able to observe how contact patterns change with time by observing the whole palate but for objective analysis it is useful to be able to extract a single value which represents the feature of change that is of interest. Common values used to analyse EPG dynamics are:

1. Palate Contact Totals over
   - The Whole Palate
   - The Alveolar region
   - The Palatal Region
   - The Velar Region
2. A Centre of Gravity Measure (CoG) which indicates whether the contact is at the front of the palate or at the back.

These values can all be displayed in the 'EPG Analysis Values' display (Figure 26).

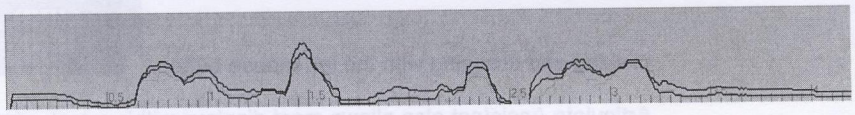


Figure 26 The EPG Analysis Values Display

It is possible to select which values to display by clicking the **right mouse button** in the 'EPG Analysis Values' display and clicking the corresponding value in the popup menu.

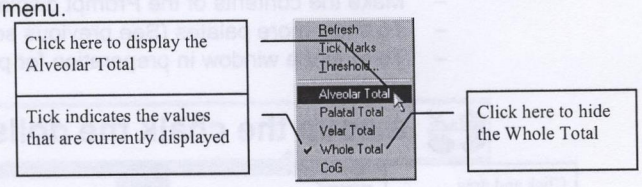


Figure 27 EPG Analysis Values Popup Menu

Finding Maximum and Minimum Contact Points

It is possible to find maxima or minima of any EPG Analysis Value using the '**Threshold...**' option in the Popup menu in Figure 27.

The 'Threshold Dialogue' box shown in Figure 28 allows the user to either:

1. Automatically annotate all regions falling within the chosen threshold values for the chosen EPG value in the across the whole file.
2. Automatically annotate all regions falling within the chosen threshold values for the chosen EPG value <u>and</u> within the selected region.
3. Automatically annotate maximum or minimum points falling within the chosen threshold values for the chosen EPG value
4. Automatically annotate maximum or minimum points falling within the selected region of the file.

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5. Automatically annotate maximum or minimum points falling within the whole utterance

Or

6. Simply highlight the first instance of any of the above rather than annotating.

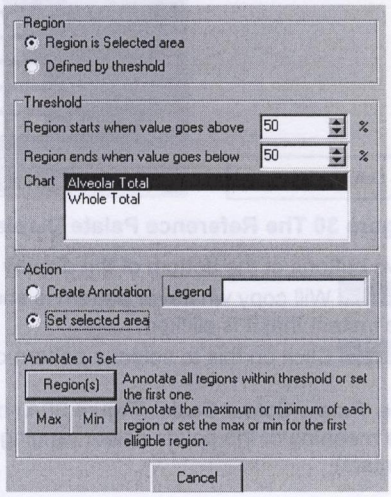


Figure 28 The Threshold Dialogue Box

The 'Legend' box provides a means for labelling each annotation. If there is more than one annotation generated by this dialogue then a numeric index is automatically added to the end of the legend to distinguish them.

The EPG Feedback Task Window

The 'EPG Feedback Task Window' (Figure 29) is designed for live feedback using the EPG. It allows the client's production in the clinic to be compared with typical productions or a previously saved 'best effort' by the client.

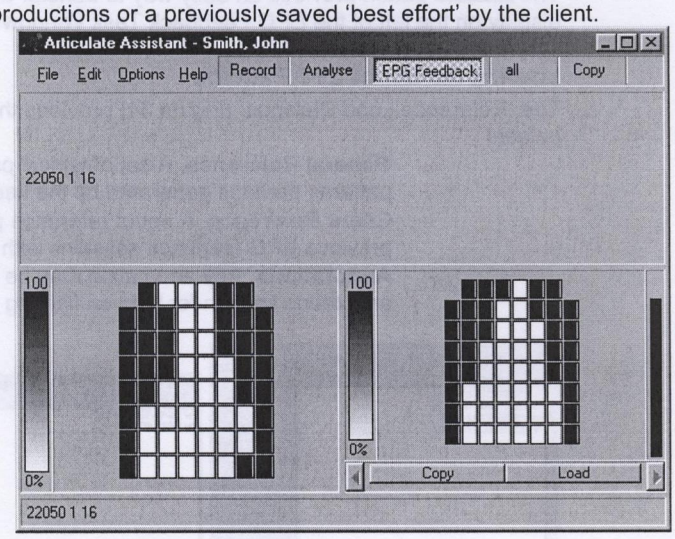


Figure 29 EPG Feedback Task Window

Comparing EPG Patterns

The 'Reference Palate Display' (Figure 30) is used to show a palate pattern (or sequence of patterns) for the client to try to imitate.

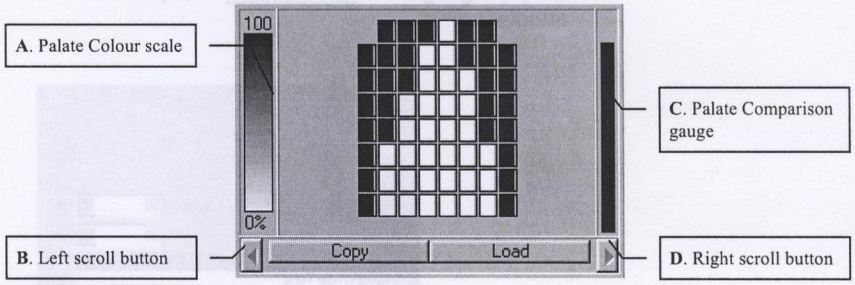


Figure 30 The Reference Palate Display

Two buttons at the bottom of the display are used in the following way:

Copy Will copy whatever pattern is showing on the live EPG palate display at the instant that it is clicked.

Load Click on this to select a pattern or sequence from a library.

The 'Palate Colour Scale' (Figure 30**A**) on the right of the palate display indicates the meaning of the palate colour ranging from 0% (no contact) to 100% (full contact).

The 'Palate Comparison Gauge' (Figure 30**C**) on the left of the 'Reference Palate Display' shows how similar the live palate is to the reference palate.

The left and right scroll buttons (Figure 30**B**, Figure 30**D**) allow the user to scroll through a palate sequence if an EPG sequence rather than a single EPG frame is loaded.

Copying EPG Patterns to Reference Display

The Copy button provides an easy way to transfer a pattern from the live palate display on the left of the EPG Feedback Task Window

Loading Reference EPG Patterns

The 'Reference Load Dialogue' (Figure 31) provides three sources for reference palates

- **General Reference**. A set of typical patterns or sequences of patterns perhaps generated by the user.
- **Client Reference**. A set of reference patterns saved from previous EPG feedback sessions with the client.
- **Annotations**. Any annotation may be loaded as a reference. See annotation section for help on filtering

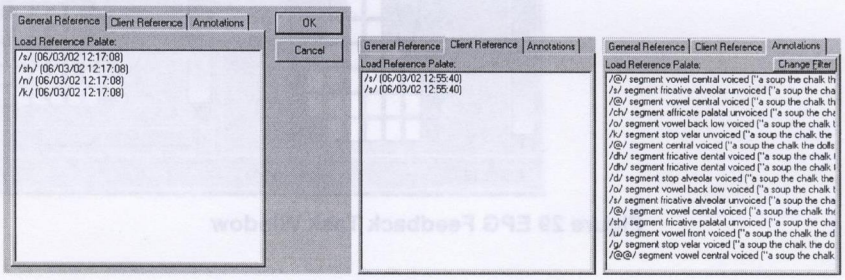
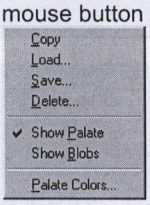


Figure 31 The Load Reference Dialogue

Saving Reference EPG Patterns

It is possible to save the pattern displayed on the 'Reference Palate Display' by clicking the right mouse button in the 'Reference Palate Display' window to reveal



the popup menu then selecting the '**Save...**' option. The 'Save Reference Dialogue' (Figure 32) allows the pattern to be saved as:

- a general **Reference** (available to any client)

or

- the **Client's Reference** which is stored along with all other notesand files relating to the current client and which will only be accessible in the future when the current client is loaded.

The **Keywords** edit box allows the reference pattern to be labelled.

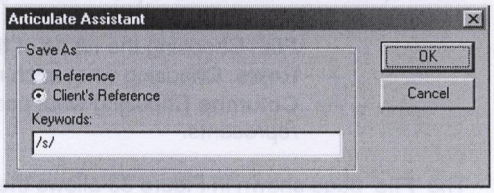


Figure 32 The Save Reference Dialogue

Comparing the Live Palate to the Reference Palate

The 'Palate Comparison Gauge' (Figure 30**C**) is a vertical gauge comprising a blue bar which rises to the top of the gauge when the live palate display and the reference palate display match exactly. The match is based on the percentage of contacts which are ON in the reference AND ON in the live palate out of the total number of contacts which are ON in the reference pattern.

Exporting Data

Specifying the Export File

Articulate Assistant provides the means to export data to a tab-delimited text file, which is suitable for importing into most spreadsheets (e.g. Excel), databases and statistical packages.

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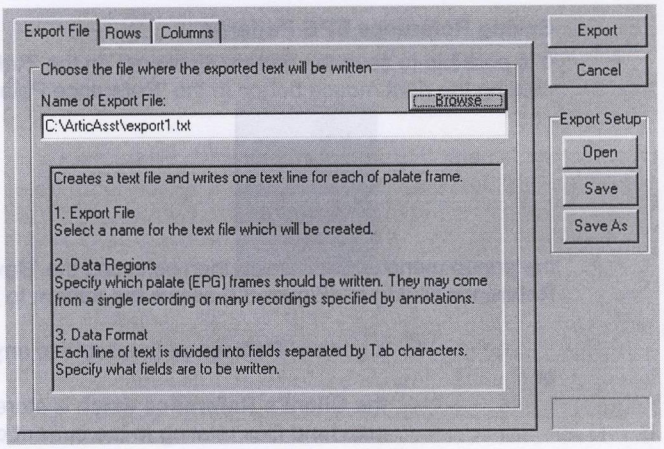

Figure 33 The Export Dialogue Box – File Name

The 'Export Dialogue Box' (Figure 33) can be invoked using the '**File:Export...**' menu option. The tabs at the top of the dialogue box can be clicked on to reveal three pages of the dialogue:

- **File**. Choosing the name of the exported text file and its location.
- **Rows**. Choosing what each row of the export file contains
- **Columns** Choosing what each column of the Export file represents.

The '**File**' page shown in Figure 33 allows the name and path of the export file to be specified. The Browse button provides an easy way to search your computer for the folder you wish to save the exported file in.

Specifying which EPG Frames to Export

Each row of the export file corresponds to an EPG frame. The frames chosen for export are defined using the '**Rows**' page of the dialogue (Figure 34). The buttons at the top of the page define the rows as follows:

- **Client**. All EPG frames of the current client will be exported.
- **Client + Prompt**. All frames of all recordings of the current prompt will be exported.
- **Current**. All frames of the current prompt will be exported.
- Selected. All frames of the currently selected region of the current file will be exported.
- **Annotation**. This by far the most common setting for row selection and it allows more detailed control over the frames to be exported.

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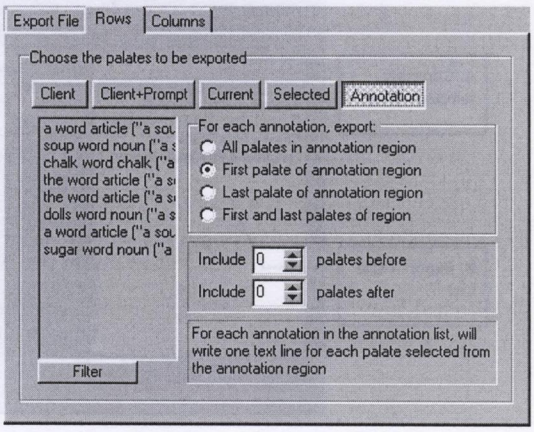


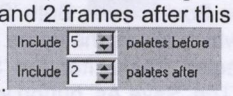
Figure 34 Export Row Definition

With the '**Annotation**' setting, it is possible to specify which palates within each annotated region are exported. The Choices are:

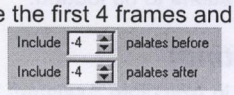
- **All palates**. All EPG frames in each annotated region
- **First palate**. Only the first EPG frame of each annotated region.
- **Last palate**. Only the last palate of each annotated region.
- **First and Last palates**. Only the first and last EPG frames of each annotated region.

It is possible to include or exclude frames around the annotation boundaries.

Example 1: You may have annotated the frame of maximum EPG contact in every example of a /t/ segment for a client. It is possible to export the 5 frames before and 2 frames after this annotation in order to provide context.



Example 2: You may have annotated all /s/ segments recorded by a client. Transitions into an out of a segment are often co-articulated. It is possible to exclude the first 4 frames and last 4 frames of each annotated segment using this setting.



The 'Export Dialogue' uses the current 'Annotation Filter' setting but for convenience the '**Filter**' button is provided to allow the setting to be changed within the Export Dialogue. Note that the filter setting is not stored in the setup file. See section on Annotation for instructions on use of the 'Filter Dialogue'.

Specifying which Data Values to Export

The '**Columns**' page of the 'Export Dialogue' (Figure 35) allows the user to specify which values are to be exported for each EPG frame. The 'Export Value List' (Figure 35**B**) shows the values listed in the order that the will appear in the export file. Buttons below this window have the following function:

- Add. Adds another value to the list.
- Delete. Deletes the currently selected value from the list.
- Swap. Moves the currently selected value to the bottom of the list.

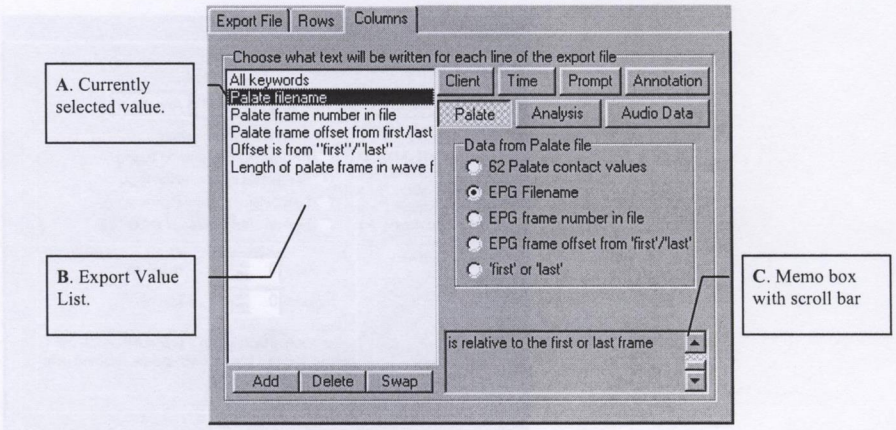


Figure 35 Export Column Definition

The buttons 'Client', 'Time', 'Prompt', 'Annotation', 'Palate', 'Analysis' and 'Audio Data' on the righthand side of the '**Columns**' page change the currently selected value when clicked on. The buttons' function is explained in the memo box (Figure 35**C**) in the bottom rigthand side of the '**Columns**' page. Note that it may be necessary to use the scroll bar to see the whole description.

Saving and Retrieving Your Export Configuration Setup

Configuration of the export file can be quite elaborate but once it has been determined the configuration can be saved in an *.xsu file using the 'Export Setup' within the 'Export Dialogue Box'

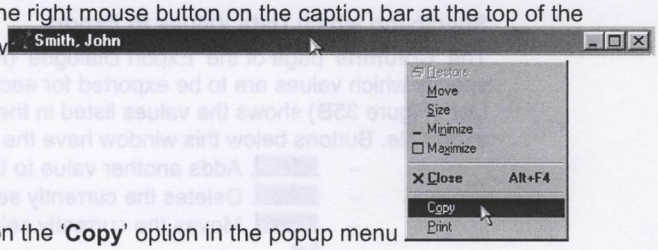
. Both 'Save' and 'Save As' buttons will bring up a dialogue which allows the name and location of the configuration setup file to be selected. Thereafter, the 'Save' button will save any subsequent changes to this file. The 'Save As' button will always bring up the dialogue to choose a name and location. This makes it easy to make minor changes to a configuration and save as an alternative setup. The 'Open' button allows previously saved configurations to be loaded.

Copying Displays (Printing)

It is possible to print any display in Articulate Assistant by copying the window to a graphics program such as 'Paint' or word processor such as 'Word for Windows'.

Copying to Word for Windows

To copy a display:

1. Click the right mouse button on the caption bar at the top of the window 

2. Click on the '**Copy**' option in the popup menu

Then open 'Word for Windows' and click on the '**Edit:Paste Special...**' menu option and click on the 'OK' button in the 'Paste Special' dialogue box.

Specifying Copy Colour

The Window will be copied in 'Grey scale'. It is also possible to copy the window in 'Black and White' or 'Full Colour'. To change the colour, use the '**Options:Color:Copy**' menu and select your choice of colour option.

The Copy Task

The 'Copy Task' comprises two windows.

1. A main window with menu, task buttons and prompt list
2. A second window with waveform/annotation, spectrogram, palates and EPG values which is ideal for copying to 'Word for Windows'.

The result of copying the tutorial data to Word is shown in Figure 36.

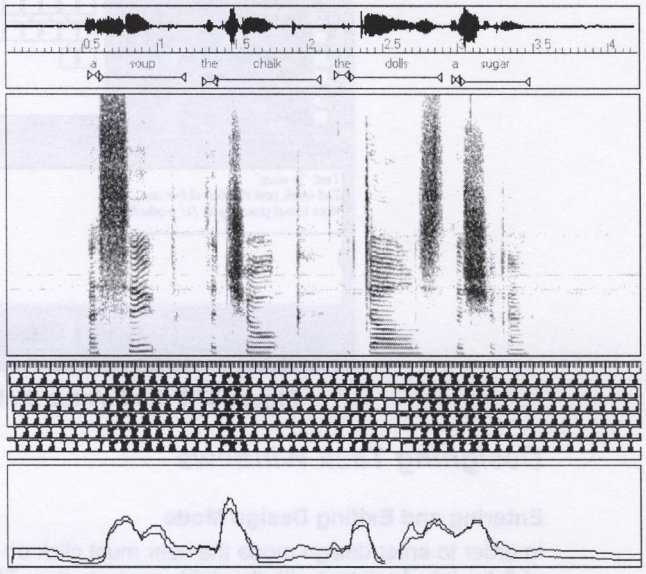


Figure 36 The Copy Task Window pasted directly into this manual

Other configurations of displays can be designed if needed. See the section on Designing new Task Windows.

Printing Palates

It is easy to print a sequence of numbered palates (left to right on the page) along with details about the palate sequence. This may typically be used in the clinic to keep a paper record of patient progress.

To print palates, select the '**File:Print Palates...**' menu option and the dialogue box shown in Figure 37. Note that this menu option is disabled until a specific file has been selected. The dialogue allows the user to adjust how many palates can be fitted onto a page by varying the number of 'Palates across page'. The user can choose to add information to the top of the printed page. Checkboxes are provided to select information already held in the computer. Additional free test can be added. For example, the specific segment, word or phrase being spoken can be noted along with comment on the particular feature of interest. See Figure 37 for an example.

A print preview screen (Figure 37**A**) shows an outline of the 1st page layout before it is printed. The dialogue also states approximately the number of pages required for the printout.

The 'Print Palates...' option should work with any printer installed on the users PC. The choice of printer and printer options can be changed using a windows standard dialogue provided for convenience under the '**File:Print Setup...**' menu option.

Note: HP laser printers can be very slow (20 mins) at spooling and printing a page of palates. Inkjet printers are much faster (about 30secs per page). This is due to differences in the drivers provided by printer manufacturers.

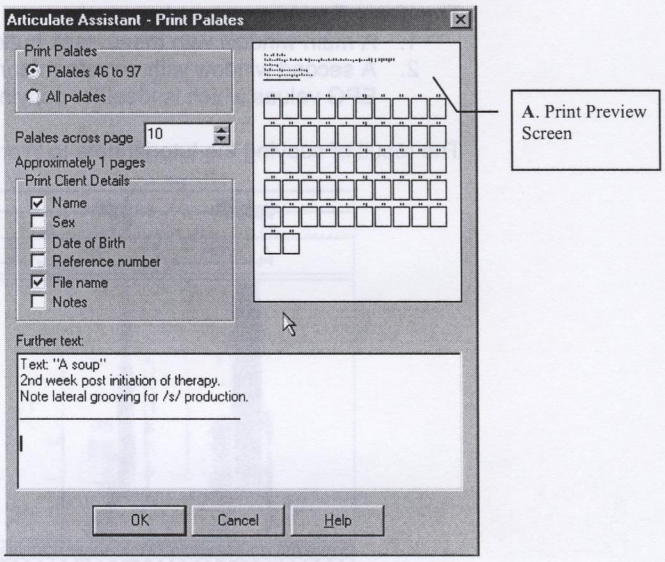
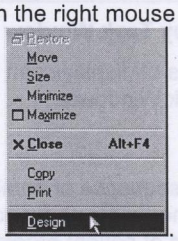


Figure 37 Print Palates Dialogue

Designing Task Windows

Entering and Exiting Design Mode

In order to enter design mode the user must click on the caption bar (Figure 10**A**) of Articulate Assistant with the right mouse button. Then select the 'Design…'



option in the popup menu .

Note: If there is more than one window with a caption bar (e.g. The Copy Task Window) then only the Caption bar with Articulate Assistant written in it has the 'Design' option

The 'Design Dialogue' list will then appear (Figure 38).

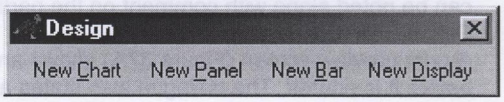
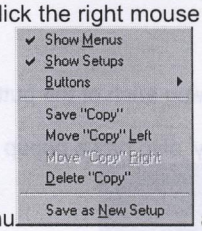


Figure 38 Design Dialogue

To exit design mode without saving any changes simply close the 'Design Dialogue by clicking on the ☒.

Saving Design Changes

Saving changes must be done before exiting design mode. To save changes made in design mode, click the right mouse button in the Task Bar (Figure 10**B**)



to reveal the popup menu and click on '**Save "<Task name>"**' ('Save "Copy" ' in this example).

Charts, Panels, Bars and Displays

Task windows are made up of modules that dock together and can be resized and positioned to create an ensemble suited to a particular task. Modules fall into 4 categories as follows:
Charts. Any module which has a display with a time axis .
Panels. Modules that do not fall into the other 3 categories
Bars. Modules that cannot be resized in normal operation
Displays Any module with a graphical display, which doesn't have a time axis

Articulate Assistant V1.0 supports the following modules:
Charts

- **Analysis Values**. EPG analysis values
- **Palates**. *
- **Wave**. *
- **Spectrogram** *

Panels

- **Prompts.** * Prompt list box
- **Annotations.** * Annotation Editor
- **Prompt.** *

Bars

- **Status**.
- **Menu**. Menu, Task Bar and buttons

Displays

- **Palate** Reference and live palate display
- **Analysis Values** Key to Analysis Values Chart and numerical readout

Modules marked with a '*' are limited to one instance per Task Window.

To create a new module, simply select it from the menu in the 'Design Dialogue'.

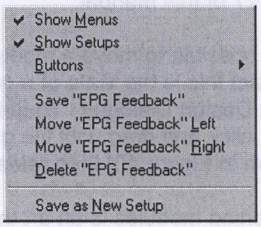
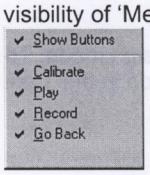


Figure 39 Menu/Task/Button Bar popup menu

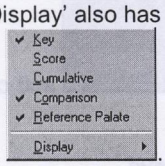
The 'Menu Bar' can be configured further by right clicking in it to bring up the popup dialogue (Figure 39). The top three options in this popup menu control the

visibility of 'Menu', Task 'Setup Buttons' and 'Buttons'. There is a submenu



allowing each of the buttons to be enabled or disabled.

The 'Palate Display' also has a popup dialogue to control the visibility of elements



of the display . The elements consist of:

- **Key**. Colour scale
- **Score**. Variability Index
- **Cumulative**. Cumulative contact check box
- **Comparison**. Palate comparison gauge

It is also possible to specify whether the 'Palate Display' is a '**Reference Palate Display**'. Note: Only one 'Reference Palate Display' permitted per 'Task Window'.

Repositioning a module in a Task Window

To rearrange the modules in a Task Window, click and drag the ▨ in the top left corner of the window (or the ‖ at the left edge in the case of 'Bar' type modules).

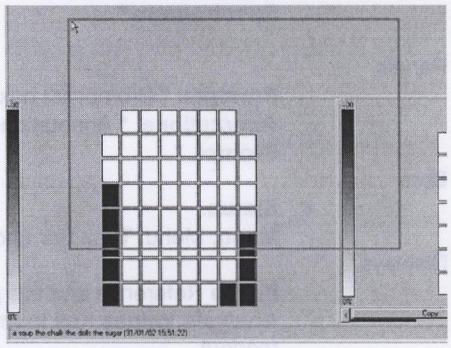


Figure 40 Rearranging Modules in Design Mode

Figure 40 shows the grey outline that will move about the screen and 'dock' in positions relative to other modules. When you are happy with the position release the mouse button. The relative size of the module can be adjusted as described on page 27 of this manual.

It is also possible to move a module so that it exists in a separate window on its own. In fact this is the state of a new module created by selecting a menu option from the 'Design Dialogue'. To get a module to be separate from the main window , click and drag until the grey outline is not aligned with the other modules (as shown in Figure 40) then release the mouse button.

Repositioning modules is an art that improves with practice.

Deleting a Module from a Task Window

To delete a module from a Task Window move the module so that it exists in a separate window on its own (as described in the previous section) then close that window by clicking on the ☒.

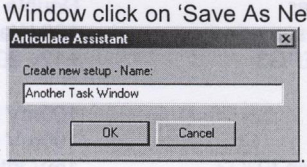
Reordering the Task Bar Buttons

It may be desirable to change the order in which the Task Bar buttons appear. To change the order click the right mouse button in the 'Menu/Task Bar' to bring up the popup menu (Figure 39). The Task Bar button corresponding to the current can be moved left or right one place by selecting the appropriate popup menu option. Repeat this to move the button one space each time.

> **TIP**: Articulate Assistant always starts in the first Task Window as defined by the order of the Task Bar buttons. To get Articulate Assistant to open in the Analysis Task simply move the Analysis Task button left so that it is first in the row.

Creating a New Task Window

To create a new Task Window click on 'Save As New Setup'. Fill in the name of



the new Task Window . A duplicate of the current window will be created. Then rearrange this new Task Window to suit.

Deleting a Task Window

To delete a Task Window, first select the Task Window to be deleted. Then use the menu/task/button popup menu and click on the 'Delete "<task window>" ' option (e.g. 'Delete EPG "Feedback" ' in Figure 39).

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4 Technical Details

The SPI incorporates its own microprocessor to control the EPG3 scanner under the instruction of the host computer via the RS232 19,200 Baud serial link. This method eliminates the need for any special hardware or drivers within the host computer.

Specifications

SPI V1.0

Power Supply 50/60Hz	240v AC 50/60 Hz. Internally switchable to 110v
Transformer	Double Wound Toroidal 5kV isolation.
Power consumption	120 Watts
Power to EPG3	+12v 200m/a
Line Input	100mV rms 20-20kHz + and – 1dB
Lx Input	100mV rms 0-20kHz + and – 1 dB
Mic Input via EPG3	1mV into 600 ohms 20-4.5kHz opto-isolated.
Chan A o/p 10kHz 16 bit	2v pp to suit host computer line input A RED
Chan B o/p 10kHz 16 bit	2v pp to suit host computer line input B BLACK
Serial RS232	25 pin connector direct (not nul modem).
Palate Sample Rate	100 per second.
Real Time Display Rate	VDU refresh rate.
Data and Control I/O	Filtered to reduce EMC
Approvals	FCC and European RFI tested.
Case Dimensions	284 x 278 x 85
Weight	2.445kg
Buzzer frequency	_____Hz
Serial Number	_____

EPG3 Scanner

Power from SPI	+12v 200m/a
Approvals	FCC and European RFI tested.
Case Dimensions	265 x 278 x 60
Weight	1.186kg
Serial Number	_____

Medical Isolation Transformer

Power Supply	240v AC 50/60 Hz. Switchable to 110v 50/60Hz
Transformer	Toroidal isolation transformer rated 260VA.

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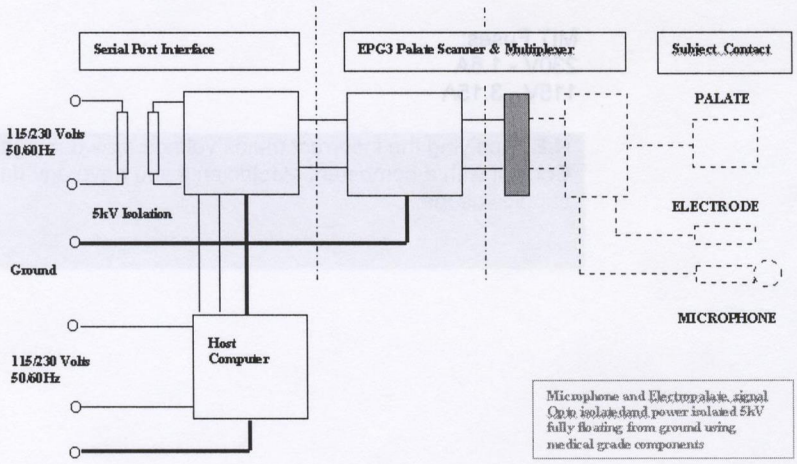
Transformer Approval	EN60601-1
Typical Leakage Current	0.095mA
Case Dimensions	280 x 155 x 90
Weight	4kg
Serial Number	_____

Electrical Safety

The electrical safety of WinEPG has been a major consideration during design of the system hardware. The design includes fully floating opto-isolation of the multiplexer and EPG palate with medical grade components used throughout. To comply with CE class IIa medical device safety requirements it is also necessary to use a medical isolation transformer (which can be supplied if not already available) approved to EN60601-1. All electrical equipment connected to the EPG system must be supplied and earthed via the medical isolation transformer.



Warning

Safety of the EPG palate wearer depends upon isolation of the components in contact with the subject from ground and from the main power supply. Nothing should be attached to the patient or to components connected to the patient, which might compromise the isolation provided. If in any doubt over this requirement, consult a competent electrician.

Changing the operating supply voltage setting

Mains voltage setting for U.S. 110V 60 Hz supplies may be used to power the EPG3/SPI system.

SPI

Selection may be achieved by setting an internal switch under the safety cover of the power supply unit within the SPI.

To alter the setting:

1. Switch off the power supply and disconnect the power cable.
2. Remove the SPI case lid by unscrewing the four screws retaining the case feet.

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3. Select the desired 115v or 230v position using SW1, which can be accessed, through the window in the aluminium enclosure, which guards the high voltage cables and components.
4. Replace the cover and close case.

MIT

Selection may be achieved by setting the switches acessable through the small windows on the rear of the MIT case next to the fuse holders. Both the input and output voltages should be set to the mains voltage for the country in which the system is used

To alter the setting:

1. Switch off the power supply and disconnect the power cable.
2. Use a screwdriver inserted through the window to slide the red voltage selection switch up or down so that the text on the switch shows the desired voltage.
3. Make sure that the fuses are correctly rated for the selected voltage.

MIT Fuses:
230V - 1.6A
115V - 3.15A

N.B. Applying the incorrect mains voltage may damage the equipment. Consult with a competent electrician if you have any doubts as to your supply voltage.

Serial Port Interface

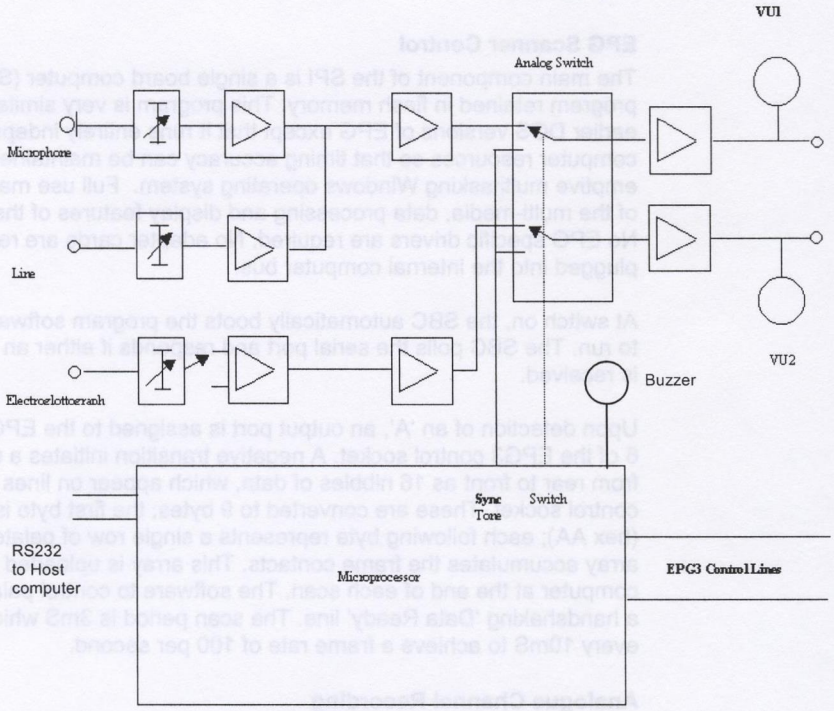

Figure 7. Serial Port Interface Block Diagram

The Serial Port Interface (SPI) enables a host computer to control the EPG3 palate scanner over an RS232 communications channel, normally the com1 or com2 port by means of single byte character codes. Each palate frame is returned via the serial link to the host computer in 9 bytes.

SPI response to ASCII character codes sent by the host computer:

'A'	The scanner scans a single frame and returns the 9 bytes of information to the computer for real time display.
'B'	Requests a number of frames to be collected and then proceeds to collect the specified number of frames.
'C'	Starts continuous scan preceded by 1 sec tone -stopped by 'D'.
'D'	Stops a running routine and closes down any hardware timers.
'E'	Starts continuous palate scan - stopped by 'D'.
'F'	Starts continuous tone for analogue channel test.
'T'	Inserts 100mS tone burst after completion of frame whilst running 'E' then the scan continues until 'D'.

These are stored in the SPI until the scan is complete and then to whole sequence is returned to the host computer for storage as a '.EPG' file.

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Communication is at 19,200 Baud, 8 data bits, no parity, 1 stop bit and hardware flow control.

EPG Scanner Control

The main component of the SPI is a single board computer (SBC) which runs a program retained in flash memory. This program is very similar to that run in the earlier DOS versions of EPG except that it runs entirely independent of the host computer resources so that timing accuracy can be maintained in spite of the pre-emptive multitasking Windows operating system. Full use may therefore be used of the multi-media, data processing and display features of the host computer. No EPG specific drivers are required. No adapter cards are required to be plugged into the internal computer bus.

At switch on, the SBC automatically boots the program software and commences to run. The SBC polls the serial port and responds if either an 'A' or 'B' character is received.

Upon detection of an 'A', an output port is assigned to the EPG3 trigger input, line 6 of the EPG3 control socket. A negative transition initiates a scan of the palate from rear to front as 16 nibbles of data, which appear on lines 1-4 of the EPG3 control socket. These are converted to 9 bytes; the first byte is for error checking (hex AA); each following byte represents a single row of palate contacts. A 9-byte array accumulates the frame contacts. This array is uploaded to the host computer at the end of each scan. The software to control palate data flow scans a handshaking 'Data Ready' line. The scan period is 3mS which may be repeated every 10mS to achieve a frame rate of 100 per second.

Analogue Channel Recording

Three analogue channels are provided.

Microphone

The microphone feed comes from the EPG3 microphone pre-amplifier which is opto-isolated (NB. On old EPG3 units the microphone input is band limited to 4.5kHz).

Line

A line input is provided to enable a high quality microphone and pre-amplifier to be connected. This channel contains no bandwidth limiting so enables use of the full bandwidth of the host computer soundcard at the selected sample rate. This facility is provided since the spectrogram in the Analyse program will soon be extended to 11kHz to enable fricatives to be better analysed.

Laryngograph

A D.C. coupled Laryngograph channel ensures absence of phase distortion. There is internal provision for inverting the signal should the user require a specific polarisation of signal to be displayed from a chosen Laryngograph.

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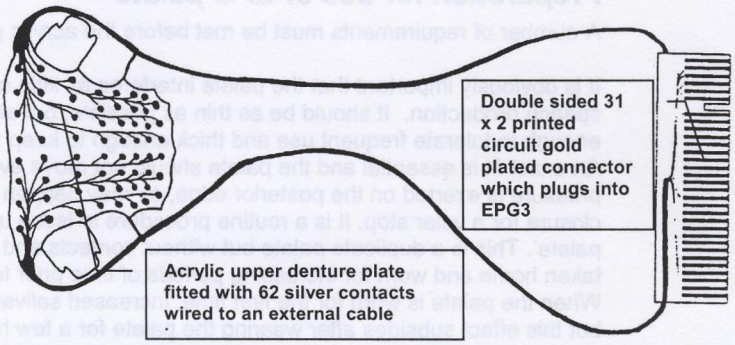
5 EPG Palate Assembly



The essential component of the EPG system is an artificial palate custom built to fit the subject's mouth. This is made from acrylic, moulded to fit the upper palate and teeth, and carries 62 miniature silver contacts exposed to the lingual surface.

Palate Layout

These are arranged according to a predetermined scheme based upon anatomical landmarks. This ensures adequate coverage of the entire palate including such phonetically important areas such as the region near the junction between the hard and soft palates and the lateral margins close to the teeth. The procedure involves first marking the positions for the contacts on a plaster model of the subject's upper palate and teeth. Three reference lines are then traced out on the surface:

- A line drawn horizontally across the top of the model through the palatal junctures of the upper front incisors.
- A line drawn horizontally through the mid-point of the juncture between the hard and soft palates.
- A line drawn vertically down the centre of the palate.

The 62 contact positions are arranged in eight horizontal rows with eight contacts in each row, except the first (the most anterior), which has six (see Figure).

The most anterior and most positive rows constitute the two horizontal reference lines ([i] and [ii] above). Along these lines the contact positions are marked out at equidistant intervals with the most lateral ones just inside the teeth. The remaining rows are arranged so that the spacing between the front four row contacts is half of that of the back four row contacts. As with the first (most anterior) and eighth (most posterior) rows, the contact positions are equally spaced across the rows. The contact positions are marked out on the plaster cast and used as a guide for placing the contact during the palate manufacturing process.

The contacts themselves are thin silver discs, 1.4mm in diameter, each connected to a 46cm length of 41 standard wire gauge enamelled copper wire. The bundles of wires are brought to the posterior corner of the palate, usually behind the wisdom teeth (in adults) and are fed out of the mouth via the buccal surfaces of the maxillary dentition. The wires are protected by soft heat-shrink tubing.

The choice of anatomically-based reference lines and the proportional spacing of the contacts ensure that different palate sizes can be compared with reference to specific rows and contact positions during articulation analysis. Thus for example,

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row number three (third from the edge of the alveolar ridge) will stand will stand in more or less the same relationship to the palate and teeth in different subjects.

Preparation for use of EPG palate

A number of requirements must be met before the acrylic palate is satisfactory.

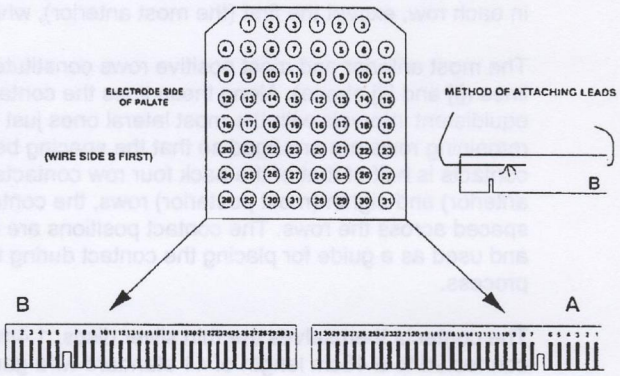
It is obviously important that the palate interferes as little as possible with normal speech production. It should be as thin as possible, but at the same time robust enough to tolerate frequent use and thick enough to keep its shape accurately. An exact fit is essential and the palate should not move even when considerable pressure is exerted on the posterior edge, as may happen for example during the closure for a velar stop. It is a routine procedure to issue users with a 'practice palate'. This is a duplicate palate but without contacts and wires, which can be taken home and worn for increasing periods of time prior to clinical sessions. When the palate is worn for the first time, increased salivation normally occurs, but this effect subsides after wearing the palate for a few hours. Occasionally a user is sensitive to the presence of the palate in the mouth. This is usually overcome after it has been worn a few times. The age of the user does not appear to be a significant factor in tolerating the palate. Some, as young as four years old, have found the palate quite comfortable to wear.

Audio recordings can be made with and without the palate being worn in order to estimate the effect that the presence of the palate is having upon speech.

If a user wears a denture, then it is a straightforward procedure to make a duplicate denture with contacts embedded in it. This has the added advantage of not requiring an adaptation period, since the user will already be used to wearing the denture. Children's teeth can move slightly over a period of time, or they may lose teeth. This may happen, for example, if the child requires EPG treatment, which extends over a considerable length of time. In these circumstances, it is advisable for a dentist to adjust the wire retention clasps.

Wiring Connections for the EPG Palate

Figure below shows the correspondence between the contacts and the actual contacts on the connector plug.



Care of the EPG Palate

To clean the palate after use, rinse in warm water, and if necessary clean with a soft toothbrush and mild detergent (keep the multiplexer connector dry). Wipe dry with tissues. Always place the palate back on the plaster cast when not in use. Try not to subject the wires to any undue tension, or coil them excessively.

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Manufacturers of EPG palates

The process of manufacturing the palates is a skilled process and is currently carried out by two firms of dental technicians in the U.K.

Incidental, (John Broughton)
Suite 14, Building 169,
Greenham Park,
Newbury, Berkshire.
RG19 6HW
U.K.
Tel. +44 (0)1635 521807

Grove Orthodontics,
59, Neville Road,
King's Lynn,
Norfolk.

In order to manufacture a palate, the manufacturers need to have a full impression or cast of the upper palate and teeth. These can be obtained by conventional procedures from any dental practitioner. The impression should be accurate, free of air bubbles and extend back as far as the junction between the hard and soft palates. A plaster cast is then made from this impression. In the case where dentures are worn, contact the palate manufacturer for detailed requirements.

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6 Troubleshooting

Frequently Asked Questions

Q. After I've recorded a sentence, the prompt moves on to the next sentence. I want to record several repetitions of the same sentence. How do I get it to stop doing this?
A. Find the checkbox marked 'Auto Advance' in the panel at the bottom of the Record Task Window and click on it so that the tick disappears.

Q. What is the clipboard.
A. The clipboard is a bit of memory used by the Windows operating system to store images and text. The images and text are then available for 'pasting' into any application running on the PC.

Q. I get messages saying "Error in CalcVolume" or "Error in Calibrate". What can I do about them?
A. These messages sometimes occur when the computer is low on resources. In windows 95 and 98 resources can be depleted by repeated cutting and pasting of large objects such as pictures. The only way to resolve this is to close down all applications and restart the computer.

Contact

If you are experiencing problems with the hardware or software which are not covered in this manual, you can contact

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The website provides downloads, a discussion board, details on a range of products and a customer support section (for which you need to use the password "WinEPGuser") with updated manuals.

We are always pleased to receive suggestions for improving the WinEPG system and the Articulate Assistant software.

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